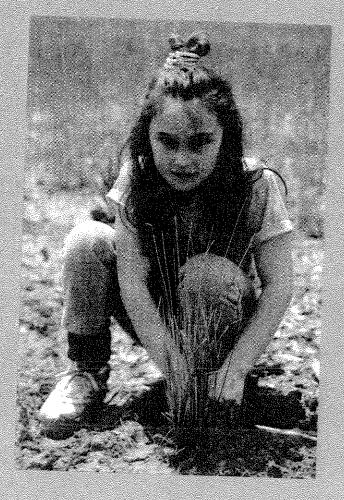
Conserving and Enhancing the Natural Environment



A Guide for Planning, Design, Construction, and Maintenance on New & Existing School Sites



MARYLAND STATE DEPARTMENT OF EDUCATION

R

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FOREWORD

Our perception of a public school site has changed from a limited educational resource, primarily supporting physical education and recreational activities, to a rich outdoor classroom supporting all aspects of the curriculum. Conserving and enhancing the natural environment on school sites in the form of forests, wetlands, meadows, streams, rain gardens, or native landscaping meets this vision. Natural environments on school sites provide a wealth of multi-disciplinary educational opportunities, many of which are "hands-on" experiences that stimulate learning.

Guidelines on conserving and enhancing the natural environment on school sites are presented to assist local school system staff, architects, landscape architects, engineers, and others involved in the school facility construction planning process. They are also provided to aid local school system staff, particularly at the school level, parents, and other community members in implementing school site projects without a concurrent construction project.

The way in which we conserve, develop, and use our school sites provides, by example, an environmental ethic to students. These guidelines promote a positive stewardship of the natural environment on school sites which, in turn, provides students with ecological and conservation principles that they can apply as adults.

Nancy S. Grasmick State Superintendent of Schools Chapter

Conservation and Enhancement of the Natural Environment

Introduction

The vision of what a school site should be has changed. The vast potential of a school site to support educational programs is being realized. It is no longer primarily a series of grassed areas and play fields designed for physical education activities and recreation, with landscaping in proximity to the building. Teachers and administrators, parents and neighbors, and most importantly students, have new ideas regarding what a school site should look like and how it should be used. Teachers and parents want a rich, diverse site that supports many facets of their educational mission. Students want a site that they can be proud of, a site that excites them, and that helps stimulate and lend reality to learning. neighbors want a site that is pleasing to the eye and adds value to the community. Environmental regulations create new challenges and opportunities for both new and existing sites. Projects that conserve or enhance the natural environment can satisfy all of these expectations. Schoolyard projects will vary in size and complexity depending on site conditions, available funding, and the desired long term maintenance

Purpose

The purpose of these guidelines is to assist local school system personnel, architects, landscape architects, engineers, and others involved in the school facility planning process. This publication will provide guidance for developing the site requirements in educational specifications and designs for new building construction and major renovation and/or addition projects for existing schools.

These guidelines will also assist local school system staff, particularly at the school level (e.g., principals and teachers), parents, and other community members to conceptualize and implement school site projects without a concurrent construction project.

The Importance of Conserving and Enhancing the Natural Environment

School sites should be designed or modified to conserve or enhance the natural environment. The benefits are threefold: educational, environmental, and financial.

Educational Benefits

The educational benefits of school sites with diverse grounds can be divided into two areas - curricular/instructional benefits and affective benefits. These are easily achievable and together have a large impact on the learning potential of students.

Curricular/Instructional Benefits: Using school sites in support of curricular and instructional goals is important. Conserving and enhancing the natural environment on school sites directly supports the goals in the environmental education bylaw (Code of Maryland Regulations 13A.04.17) of the State Board of Education. The bylaw defines the requirements of a multidisciplinary environmental education program that must be provided to students.

Using basic skills to solve real-world, authentic problems is fundamental to the success of accountability programs such as the Maryland School Performance Assessment Program (MSPAP). Many of the highest scoring schools and some of the first schools to meet state performance standards on MSPAP make extensive use of the school site. Using the rich learning opportunities presented by meadows, gardens, trees and forests, and wetlands or ponds on the school site can bring authenticity, excitement, and valuable educational resources to an instructional program.

Another important purpose in conserving and enhancing the natural environment in the schoolyard is to instill an environmental ethic by example — not just by words in a textbook. As we teach environmental

"If students learn about ecological principles in the schoolyard, perhaps children will grow up to apply these principles in their communities and in their own backyards."

education, we should practice conservation principles in the landscape around us. We should understand the environmental impact of clearing the vegetation from our school sites and replacing native ecosystems with acres of grass. If students learn about ecological principles in the schoolyard, perhaps children will grow up to apply those principles in their communities and in their own backyards.

Affective Benefits: Are students, parents, teachers, and neighbors proud of what the school site looks like? Are the school grounds aesthetically interesting? Is the school site unique in some manner, separating it from other schools? The school site can have a dramatic role in the development of student, teacher, and parent attitudes about the school and learning. Are there natural events happening at the site that can interest both teachers and students? Many schools have increased parental and community interest and participation in school activities by involving parents in a school site environmental restoration project.

Environmental Benefits

Recent State environmental regulations regarding trees, forested areas, wetlands, streams, and sediment/stormwater control require the development of new school site environmental management options. Later chapters in this publication on rain gardens, meadows, and wet-pond sediment/stormwater management options will detail examples of how environmental regulations can be met in ways that help the environment, save maintenance dollars over the long term, and provide important learning opportunities for students.

Two of the many benefits that natural areas provide include wildlife habitat and stream protection. Habitat for wildlife is increased by converting lawns, having low habitat value, to rich native plant communities, including meadows, forests, or wetlands. Streams,

and ultimately the Chesapeake Bay, greatly benefit by having natural habitats in their watershed as vegetation and leaf litter promote the infiltration of rainwater restoring a critical part of the water cyclegroundwater. Groundwater slowly seeps into streams providing the clean, cool waterflow necessary for all aquatic life.

Some Maryland jurisdictions use schools as sites for forest and wetland environmental mitigation projects. Some counties do this because they have a shortage of potential local mitigation sites and others because this is a simple, often very inexpensive way to enhance the school site aesthetics and usefulness for learning.

Financial Benefits

Enriching the classroom-based learning environment can be expensive. For instance, studying the development of butterfly larva or tadpoles is a typical instructional activity. Does one have to buy the animals from a catalogue and buy the cages and tanks or does one simply observe and study the development of these animals in an on-site meadow. wetland, or pond? Are there opportunities to help students meet service learning graduation requirements through environmental restoration projects on the school site or is transportation or busing provided to sites off campus? Many schools have saved significant funds because they utilize those habitats available at their school.

A school site that is primarily turf has significant maintenance costs and may have little positive impact on the environment. It may, in fact, have a negative effect on the environment. Portions of sites often do not lend themselves to easy mowing and maintenance. Steeply sloped areas and places that are regularly wet can be difficult and often dangerous to mow. Several school systems are realizing significant maintenance savings by converting unused turf to meadows, forests, or wetlands. Although initial costs are sometimes higher for a natural landscape feature, the long term cost savings are usually significant.

Facility planners are interested in the maximum use of building space and the best use of the school site. A survey by the U.S. Fish and Wildlife Service of 50 school sites in Maryland found that the median acreage of unused turf on elementary school sites was 2.7 acres and 4.6 acres for secondary schools. The development of natural habitats on school sites enhances the aesthetic value of the site as well as its student, teacher, and community utilization.

Student Participation

How do you best create a new site, or develop an existing site, into an educationally and environmentally rich place? The answer varies from school site to school site. However, a consistent part of the answer is to involve the students, as fully as possible, in the development and completion of the projects.

Students at Grasonville Elementary (Queen Anne's County) and Hollywood Elementary (St. Mary's County) Schools wrote grant applications to support much of their school site restoration projects. Students at Sussex Elementary School (Baltimore County) and other schools are raising the plants that will be planted on their sites. Students in Harford and Cecil Counties, and in Baltimore City are actively part of forest and riparian forest planting projects that also reduce mowing maintenance costs. Wetlands restoration projects in Anne Arundel, Baltimore, Cecil, Garrett, Harford, Queen Anne's, and St. Mary's Counties have

been planned by students. Student, parent, and community involvement strengthens interest and greatly increases the educational value of a project.

Achieving Success

As with any aspect of school design, the goal for school site conservation and enhancement projects is to achieve the maximum benefit for the greatest number of years.

Research from a nonprofit organization in Great Britain called Learning Through Landscapes, found that three important principles need to be followed to realize maximum benefits from a school site conservation or enhancement effort:

<u>Holistic</u> - involving the entire school community and all aspects of the curriculum;

<u>Participative</u> - involving students with adults in as many aspects as possible; and

<u>Sustainable</u> - involving continuing consideration of the use, design, management, and maintenance of school grounds as part of a school's ongoing development and planning.



Judith A. Resnick Elementary School, Montgomery County Public Schools

Chapter 2

The

Planning Process

The Process

In planning a major, new, or renovated facility, a school system must translate an educational philosophy into a detailed design. In order to ensure that the facility is well-designed, many points of view and areas of knowledge must be tapped. A planning committee is assembled to bring together individuals with the diverse experience required. The committee will see the project progress through a number of distinct phases, from inception to occupancy. Although the process will vary from project to project, the following steps outline a typical process:

Planning

- Project approval and site selection
- Planning committee and planning subgroup formation
- Committee discussions and decisions on program, philosophy, content, staffing, organization, etc.
- Educational specifications preparation
- Selection of an architect
- Completion of forest stand delineation plan when required

Design

- · Pre-design meeting with the architect
- Schematic design
- Design development
- Preparation of construction documents
- Completion of forest conservation plan when required

Construction

- Bidding and contract award
- Construction
- Acceptance of project and occupancy of facility

Occupancy

- Installation of moveable equipment and furnishings
- Occupancy
- Post-occupancy evaluation

Site Selection

The site selection process enables a school system and the State to objectively review the suitability of potential school sites. In addition to local approvals, the approval of the State Superintendent of Schools and the State Interagency Committee on School Construction (IAC) is required for the acquisition of all new sites. Site approvals are required from the following State agencies prior to submittal of the site for IAC and State Superintendent approval.

- Department of Natural Resources (DNR) will review for issues related to wetlands (tidal and nontidal), endangered species, flood plains, Chesapeake Bay Critical Area, coastal zone consistency, forest and tree impact, recreation and open space, and general natural resources impact.
- Maryland Department of the Environment (MDE) will review for issues related to water and sewer service, stormwater management, soil erosion, wetlands, presence of hazardous and solid waste, air management, and general environmental impact.
- 3. Maryland Historic Trust (MHT) will review the status of the site concerning inventoried historic properties, National Register listed properties, and prior archaeological or architectural research conducted in the project vicinity. They will assess the site for potential historic properties that have not yet been identified and provide recommendations on the appropriate treatment.
- State Highway Administration (SHA) will review for possible future state roads encroachment on the site, access from State roads, and general transportation issues.

The Planning Committee

Most site development projects take place within larger frameworks such as new school construction or major renovation projects. Some projects, however, may be specifically for the conservation or enhancement of the natural environment. In either case, there will be a planning committee which has a key role in the decision making process for the overall project.

The planning committee is a collection of people with diverse interests and knowledge and provides a basis for decisions. Planning committees vary in their size and composition, but all planning committees for new construction or major renovation projects should include, at a minimum, the following:

- school principal
- · local school facilities planner
- Maryland State Department of Education (MSDE) school facilities specialist
- · local environmental education specialist
- · local maintenance specialist
- parents
- · local educational program specialists
- teachers
- · natural resource specialist

The local school system administration ensures that educational programs, budget constraints, and facilities standards are incorporated into the project. The facilities planner and/or the principal is often responsible for coordinating the process. Even while the project is being developed as a whole entity, each of its programmatic components is studied and developed individually. Development of the site, including conservation and enhancement of the natural environment, will be one of these components.

The MSDE school facilities specialist participates in an advisory role. He/she can serve as a resource on national trends, practices across Maryland, and Statelevel standards and references. The specialist can also serve as a link to MSDE instructional program specialists and other State agencies.

Planning Committee Recommendations:

- 1. The roles, responsibilities and authority of each person involved in the facilities planning process should be clearly defined and understood.
- 2. The difference should be clarified between a recommendation and a decision as it relates to the subcommittee activities and the activities of the planning team as a whole.
- Ground rules, priorities, and expectations should be established and understood by all participants.
- A positive climate for the exchange and the expression of individual ideas should be established.

Table 1

For large or complex projects, additional planning committee members may come from other government agencies, neighboring businesses, or the residential community. The planning committee should be involved throughout the entire process of facilities development, although its major impact is in the planning and design phases. Specifically, the committee should participate in the following steps:

- Preparation of educational specifications
- Interpretation of the specifications for the project architect
- Development of alternative schematic design concepts
- Review of schematic design documents
- Review of design development documents
- Review of furniture and equipment lists
- Post-occupancy evaluation

Visits to exemplary facilities may be scheduled for committee members.

Educational Specifications

Educational specifications articulate the physical requirements for the project as an outgrowth of the educational program. They must be consistent with the local educational facilities master plan and the overall project scope, capacity, and budget as approved by state and local agencies. They will guide the architect through the design and construction of the project. It is through the educational specification development process that the planning committee members have input into the conservation of existing natural site features and development of additional natural site amenities.

EDUCATIONAL SPECIFICATIONS CONTENT

- Project Rationale
 Introduction
 The community
 School board policies
 Belief statements
 Scope of work, budget and schedule
- 2. The Educational Plan
 Curriculum
 Instructional methods
 Staff support
 Technology
- 3. Project Design Factors
 Site conditions
 Building systems
- 4. Activity Areas
 General overview
 Program functions for each education
 and service program in the project
- 5. Summary of Spacial Relationships
- 6. Summary of Spacial Requirements (Net and gross square feet)

Educational specifications should highlight existing natural environments on site and include goals for conserving and enhancing the natural environment.

Educational specifications are a text document describing the site development, educational philosophy, and performance expectations for construction projects. They are needed whether the project involves new construction, additions or renovation, and are formally reviewed at the State level. The content of the specifications for projects should include the elements shown in Table 2. The outline in Table 2 is taken from Appendix D of the Public School Construction Program (PSCP) Administrative Procedures Guide. Educational specifications for a project solely focused on conserving or enhancing the natural environment would be abbreviated including only applicable sections.

It is under *Site Conditions* in Section 3 of the educational specifications that the existing natural site features should be described. This information should be taken from the forest stand delineation report required for major construction projects under the Maryland Forest Conservation Act. The forest stand delineation report identifies forest stands, 100-year flood plains, steep slopes, intermittent and perennial streams, stream buffers, non-tidal or tidal wetlands, critical habitats, and soils. When a forest stand delineation report is required, this report should ideally be completed prior to beginning development of the educational specifications, but definitely prior to initiating schematic design.

For school construction projects not requiring a forest stand delineation report, a report identifying similar information on natural site features should be completed for the school system. This information should be used to guide the educational specifications and provided to the project architect. The project architect should reference this information with the intent of identifying and incorporating into the schematic design those portions of the site designated for the conservation or development of natural environments.

Table 2

A school site project solely for the purpose of conserving or enhancing the natural environment (without a concurrent school construction project) should also include a survey of the existing natural environment on the site. The survey can be accomplished using volunteers, technical assistance from government agencies, contracted services, or a combination of these approaches.

In addition to highlighting existing natural environments on the site, the educational specifications should include goals for conserving and enhancing the natural environment. Members of the planning committee should specify existing natural site features designated for conservation and additional site development that requires investigation during the design phases.

The final educational specifications document is a record of decisions about activities for students, teachers, and administrators, and a description of the site development and building spaces required to support such activities. It becomes the basis from which the project architect proceeds with the design. It also serves as a bench mark for checking the progress of the project and the design's responsiveness to the intended programs.

Design and Construction

After the educational specifications have been completed and approved, the architect begins to transform it into a design for site development and the physical space of the building. In designing a facility, an architect starts with a general, or schematic view of the program and gradually develops a very specific response to the program requirements. The final design product is a set of instructions for contractors. Each design phase builds on the previous work and reflects a dynamic process of interaction between the architect and the planning committee.

Pre-Design - When an architect assumes the responsibility for the design project, he/she assumes a set of requirements. The foundation of these are the educational specifications, but additional requirements are building codes, safety/environmental regulations, local/state standards and procedures, constraints imposed by funding, and existing conditions. Often a

preliminary meeting is held to identify and clarify the project requirements and to interpret the specifications for the consulting architect. It is at this meeting that the importance of conservation or enhancement of the natural environment as expressed in the educational specifications should be emphasized. The planning committee, the MSDE school facilities specialists, and the architect should be present.

Schematic Design - The schematic design phase develops two or more preliminary site and building design solutions, each meeting major program goals. Schematic designs are conceptual and derive from requirements set forth in the educational specifications and good architectural and engineering practice. After evaluating alternatives, the planning committee selects one solution which the architect refines through a process of review and revision.

The architect should reference the final forest stand delineation report or other survey provided by the school system. The schematic design should specifically address areas of the site targeted for conservation or enhancement of the natural environment. Access to natural environment study areas should also be shown on the site plan.

"The schematic design should specifically address areas of the site targeted for conservation or enhancement of the natural environment."

The environmental education and program specialists on the planning committee should monitor the schematic design closely for proper site development and the overall relationships between the site development elements and program spaces in the building.

<u>Design Development</u> - During the design development phase, the basic elements articulated in the schematic design phase are developed and fine-tuned. The site development components are further detailed; building footprint and individual room dimensions are finalized; fixed furnishings and equipment are located; construction details are begun; utilities and systems are developed and located; and all aspects of the

project take on greater depth and sharper focus. The planning committee has an important role at this phase because design development represents the first opportunity to get into the details of the design and may be the last practical opportunity to make substantial changes in the project.

Cost estimates, energy analyses, and other data are presented during design development. This phase, like schematic design, will be formally reviewed at the local and state levels.

Construction Documents - During the construction document phase, the architect produces detailed documents which will form the contract for construction. The primary documents are construction drawings and written specifications. All systems and elements will be fully described, including demolition, sitework, structural work, roofing, doors, windows, finishes, equipment, plumbing, heating and cooling, fire protection, lighting, power, and electronic communications. A detailed cost estimate will be prepared. If substantial changes to the design originate outside of the planning committee, they should be brought to the key decision makers of the general committee for evaluation and acceptance.

The forest conservation plan should be completed during this phase and incorporated into the construction documents. The forest conservation plan indicates the amount of forest disturbance, protection methods for the remaining forest, and reforestation or afforestation requirements.

Some natural site features developed in the previous design phases may be incorporated into the construction documents indicating work as "not in contract" to be completed by staff and students after occupancy. A wetland, for example, may be graded in the construction contract with planting not in the contract.

When the construction documents are complete, they will be reviewed at the local level. Locally approved documents will then be reviewed at the state level. Once approved, the project can be bid for construction.

Construction - During the construction of the facility, planning committee involvement is minimal. Significant changes to the project are unusual during construction but do sometimes occur due to unforeseen circumstances. Changes which affect the site development in a substantive way should be brought back to the notice of the appropriate educational and technical staff.

Installation of Furnishings and Equipment - Once the construction is substantially complete, furnishings and equipment are installed. All warranties, operating manuals, training, and servicing of new components and systems must be obtained.

Occupancy and Post-Occupancy Evaluation - After construction is complete, the staff can move into the facility. It is at this point that staff and students will plan and complete habitats that were purposely left incomplete.

A post-occupancy evaluation can be an invaluable learning tool. Typically, a team visits the facility in the second year of occupancy. A checklist forms the basis of the evaluation, but there should be provision for comments from users. The facilities planners will use this information to revise local standards. Future planning committees will benefit from the information.

Interagency Committee on School Construction (IAC) Projects

The State of Maryland provides construction funding to school systems through the Public School Construction Program (PSCP) governed by the IAC. Projects may be funded through the PSCP as part of a new school construction, a renovation, or an addition to an existing school. PSCP staff and staff from supporting agencies - the Maryland State Department of Education, the Maryland Office of Planning, and the Department of General Services - are available to assist in all phases of project development. Refer to the *PSCP Administrative Procedures Guide* for more information.

Locally Funded Projects Requiring Approval by the State Superintendent of Schools

Locally funded school construction projects costing more than \$350,000 require the approval of the State Superintendent of Schools. A MSDE School Facilities Specialist participates in all phases of planning and design and coordinates the State review and approval for the following submissions:

- · Educational Specifications
- Schematic Design
- Design Development
- Construction Documents
- Contract Award
- Change Orders Over \$25,000

Refer to Code of Maryland Regulations (COMAR) 13A.01.02.03

Accessibility for Persons with Disabilities

Public schools must provide access for students with disabilities to all educational programs in the least restrictive manner. They also may not discriminate against employment and public services. Consequently, indoor and outdoor education facilities must be accessible to students, teachers, and public users. Title II of the Americans with Disabilities Act (ADA) requires public schools to comply with either the Uniform Federal Accessibility Standards (UFAS) or the ADA Accessibility Guidelines (ADAAG). In addition to the federal standards, the Maryland Accessibility Code (COMAR .05.02.02) also applies. Maryland architects and school system facilities planners are familiar with these requirements. They apply to site development related to new construction and building renovations. At least one accessible route must be provided that connects accessible buildings, facilities, and elements on the site. Paths must comply with Section 4.3 of ADAAG/ UFAS (See page 60 in this guide).

Accessibility guidelines were developed around adult needs. Adjustments for small children are sometimes necessary. Final federal guidelines for building elements designed for children's use were published by the U.S. Architectural and Transportation Barriers Compliance Board in January, 1998. They are not enforceable until approved by the Department of Justice but are available to school staff, parents, and designers as advisory guidelines.

Case Study: The Planning Process

Yough Glades Elementary School is a recently opened new school in Garrett County. During the design phase, the school construction team decided to carefully consider how the school site could support good habitat design and how school construction plans might include ways of suporting an instructional program that could take advantage of the school site. Staff from the Maryland State Department of Education and the Department of Natural Resources were asked to visit the site and discuss design options.

The final design situated the school to preserve forested areas and large trees, included an accessible path through the forested area, included a boardwalk that allowed access to a wetland area, and preserved large areas of established meadows. Drainage streams were designed to feed into a wet-pond, rather than a dry-pond, in order to create a pond study area.

Instructional equipment and staff development focused on how to integrate the schoolyard habitat into the school's instructional goals, with a special focus on the Maryland School Performance Assessment Program (MSPAP). Students now survey and monitor native butterfly populations that are supported by an outstanding wildflower meadow. They visit the pond and read about the many different organisms they find there. They are involved in reading, writing, and mathematics activities related to their school site. The meadow greatly reduces

Stormwater Drainage Pond Yough Glades Elementary School Garrett County Public Schools

costs associated with maintaining large unused turf areas, maintains wetland areas, and combined with the forest protection, reduces non-point runoff into the Youghiogheny Creek.

At Yough Glades Elementary School students, teachers, and the community now enjoy a vital and beautiful school site that was designed to support educational goals, and meet environmental regulations.



Boardwalk Through Wetlands Yough Glades Elementary School Garrett County Public Schools

Site Development Options

Introduction

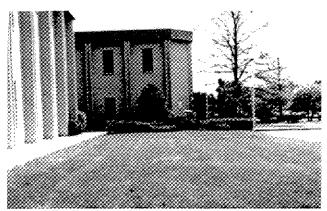
Several options for conserving or developing the natural environment on school sites are presented in this chapter. The ideal time to design and construct the suggested options is during new school construction and renovation projects. Many of the projects can be completed on existing school sites without a corresponding building construction project. Where applicable, each section includes a discussion of student participation, safety, regulatory requirements, costs, planning, design, construction, and maintenance. Other documents are referenced where more detailed information is needed. A list of additional references can be found on page D-1.

Finally, significant funding, in kind services, and donated materials are widely available to support projects. Refer to the case studies throughout this section and to Appendix A, Funding Sources, for further information.



Planting a Wetland North East Middle School Cecil County Public Schools

TATIVE PLANT LANDSCAPING



<u>BEFORE:</u> The front of the building is dominated by mown lawn and a few masses of evergreen trees and shrubs. U.S. Fish and Wildlife Service Building Annapolis, Maryland



<u>AFTER:</u> Native trees, shrubs, and flowers provide a colorful entrance to the building & attract butterflies and birds.

U.S. Fish and Wildlife Service Building

Annapolis, Maryland

Case Study: Native Plant Landscaping

Native plant landscaping on school grounds is a relatively new concept although some native plants can be found on most school planting plans. A number of organizations are promoting native plant landscaping for public institutions, corporate and commercial sites, residential communities, and individual homes. Foremost among the local programs endorsing the environmental benefits of native plant landscaping is BayScapes, sponsored by the U.S. Fish and Wildlife Service (USFWS) and the Alliance for Chesapeake Bay. School children have helped install most BayScapes demonstration projects including those at the Maryland Coastal Bays office near Assateague on the Eastern Shore and at Fort George S. Meade in Anne Arundel County.

The overall goal of the BayScapes program is the reduction of nutrient pollution in the Chesapeake Bay. The program recognizes that site development decisions affect water quality in the streams and rivers of our State and ultimately in the Chesapeake Bay. The objectives of BayScapes landscaping are relevant to school sites:

- save money and time by using low maintenance regionally native plants
- reduce the need for fertilizers, herbicides, and pesticides
- · conserve water
- save energy and reduce utility bills
- · enhance the quality and durability of landscaping
- · attract desirable wildlife
- · increase enjoyment of the property

The BayScapes installation at the U.S. Fish and Wildlife Services office in Annapolis is an excellent example of what might be accomplished at a school site. The original landscape featured a large panel of grass, with a number of evergreen trees and shrubs lining the walkway to the building entrance. To save costs, most of the original plants were left in place when the native plants were added. As with most BayScapes projects, the first aim was to save energy by reducing mowing and chemical lawn treatments. Thus, much of the grass in front of the building was eliminated and replaced by native plants that will provide a more diverse landscape and attract wildlife.

The new landscape, designed by Marie Erb, a member of the Maryland Native Plant Society, features the lovely spring and summer flowers of serviceberry, sweetbay magnolia, and redbud trees. Native shrubs like the blueberry, arrowwood viburnum, and winterberry holly offer fruit for birds. The garden is colorful from May through October with the blooms of native perennials including blue phlox, coreopsis, purple coneflower, black-eyed susan, gayfeather, butterfly weed, and aster. The little bluestem, a native meadow grass, grows to 4 feet tall and its graceful green stalks turn amber in the fall and remain attractive all winter long.

According to Britt Slattery of USFWS, the advantages of BayScapes go beyond the environmental benefits and attractiveness of the plantings. Not only does a BayScape look a bit different from a conventional ornamental landscape, people react differently to it. "People become involved." she notes. Staff members pull a few weeds as they pass by on their way to or from work, bring in stepping stones to add to the garden, and learn about plants that they can use at home. If someone notices changes in the garden, they spread the word that something new has bloomed or that a new bird or butterfly was seen. Imagine students arriving at school excited by sighting an oriole eating the blueberries, by discovering the first blossom on a magnolia tree, or by spotting a monarch butterfly perched on a coneflower.

The new planting cost \$5,000.00 and was installed by a professional contractor, Buzzuto Landscaping. According to Slattery, the installation, if done by volunteers would have cost approximately half that amount for plants, mulch, and ground preparation.

For more information about BayScapes, contact:.

U.S. Fish and Wildlife Service 177 Admiral Cochran Drive Annapolis, MD 21401 (410) 573-4500



Introduction

A schoolyard in Maryland should look different from a schoolyard in New Jersey. Similarly, a school site in Chestertown on the Eastern Shore should have a distinct character from one in Frostburg at the edge of the Appalachian Mountains. Landscaping with native plants can help provide that special identity. selecting native plants for our school grounds, we link the schools with the landscape of the region reinforcing seasonal cycles and colors. We note the passing of the year as we watch the sequence of flowering in the early spring or the gradual coloring of the forest in the fall. Native plants reinforce our sense of place, a recognition of where we are. By using native plants we are demonstrating that there is an appropriate regional expression for design, whether it is through architecture or landscape architecture.

"By selecting native plants for our school grounds, we link the schools with the landscape of the region preserving and reinforcing the region's ecosystem."

Imagine it is spring at a school on the Eastern Shore. A large island in the parking lot sports a cluster of red maples and sweetgums underplanted with arrowwood viburnums and highbush blueberries. Flanking the front entrance is a pair of American holly and hedges of bayberry and inkberry line the entrance walk. A pure stand of loblolly pine buffers the school from the neighboring property. The pines provide a backdrop for the large white flowers of the sweetbay magnolia. In the drainage ditch along the road are black willow and large masses of silky dogwoods. The students are studying Native American culture and learning that their arrows were made from twigs of the viburnum, and young willow branches were woven into baskets.

Now, travel to a school in the Hagerstown Valley. It is fall and the entrance driveway is lined with sugar maples that are ablaze with yellow, orange and red leaves. A hedgerow along the property boundary is reminiscent of the local agricultural landscape. Birds

enjoy the fruits, seeds and nuts of the serviceberry, blackhaw, cranberry bush viburnum, and hophornbeam in the hedgerow. The landscape is made colorful by the red foliage of the glossy sumac that covers the slopes near the athletic fields, and by the clear yellow leaves of the witchhazels that are massed at the corners of the building. In the spring, a local farmer will be visiting the school to show the children how to tap the maple trees for syrup. They will learn that a few generations ago families might have made jam from the berries of the viburnum and treated skin problems with witchhazel lotion.

Environmental Enhancement

The importance of environmental enhancement of public property is recognized on a federal level and supported at the state level in Maryland. In April 1994, the White House issued an Executive Memorandum on Environmentally Beneficial Landscaping. It recommended that federal properties be planted to complement and enhance the local environment using regionally native plants, minimize adverse effects on natural habitats, and promote the use of plants that conserve water and energy. With the publication of this manual, the Maryland State Department of Education is recommending similar goals for the landscaping of school properties.

Understanding what designates a plant as native is important to the discussion of native plant landscaping. Native plants are those which occur naturally in the landscape of a region or locale. They are sometimes defined as the plants that existed in that landscape prior to the arrival of European settlers. A native plant community is an assembly of trees, shrubs, and groundcovers that have arrived in a certain location and survived due to their adaptability to the landform, microclimate, solar aspect, soil, and water. Protecting and planting native species preserves and reinforces the region's ecosystem. In an ecosystem there is a mutually beneficial relationship between plants and animals. Wildlife is generally dependent upon native plants within its territory for food and cover. In turn, native plants depend on wildlife for pollination. Animals disperse seeds for the continued propagation Thus, planting native species of plant species. contributes to the continuity of this chain of life.

"A planting plan featuring native plants should be part of a comprehensive landscape design that includes forest conservation, tree preservation, landscaping, and the creation of schoolyard habitat gardens."

Contribution to Educational Programs

The landscaped areas of a school site can provide the stage for numerous educational programs. Plantings can be a source of inspiration for art, writing or other creative activities. They can be used in an environmental science curriculum to teach classes in biology, environmental management, wildlife habitat, pollution prevention, and many other related subjects. Children learn important aspects of ecology when they go outside for lessons that include the use of native plants. They might count how many living creatures they can find in a square meter of lawn, meadow, forest, or garden. They can measure the temperature on a sidewalk and compare it to the temperature on the grass and under a tree. Using the schoolyard as a classroom requires the commitment of administrators and teachers to integrate the outdoor environment into the education program. Bringing students outdoors can result in active learning, an exciting experience for children and teachers alike.

Planning, Design, and Construction

Planning for native species at a new school site first requires analysis of the site conditions and an inventory of existing plants. The Maryland Forest Conservation Act requires a natural resources inventory and a forest stand delineation report for most development proposals. A plant species inventory identifies what species are present at the site, but it can also be used to determine what species might be absent or under-represented on the site. A planting plan featuring native plants should be part of a comprehensive landscape design that includes forest conservation, tree preservation, landscaping, and the creation of schoolyard habitat gardens. Landscaping

with native species is not a substitute for preserving native forests and specimen trees. Before deciding where new plants should be located, decisions should be made about saving existing plants and, when possible, transplanting them. Careful planning will minimize destruction of native habitat. Typically, certain site areas are landscaped as part of schoolyard enhancement: the vehicular entrance to the site, pedestrian entrances to the building, courtyards, parking lots, drop-off areas, and the site perimeter. Plants with ornamental characteristics -- showy flowers, attractive fruit, colorful foliage, interesting bark, or handsome form -- are often used to frame or accent an entrance. Planting should be used to improve the microclimate by using large trees to shade the building, pedestrian pathways, play areas, roadways and parking lots. Planting may be used to deflect harsh northwest winds. The site perimeter may be planted to soften the view from the road or to screen the school from neighboring residential or commercial properties. Each situation offers an opportunity for adding native plants to the landscape treatment.

Site Planning Considerations

Native plant landscaping involves more than just preparing a planting plan as part of the construction drawings for a school site. Site planning decisions affect decisions about plant selection and planting design. Taking plant needs into account during the planning phase can help ensure healthier plantings and can make maintenance easier. The following are a few important practical recommendations that should be considered during the site planning process.

Orientation - Consider orientation during site planning and plant selection. Ornamental planting is often concentrated at the entrance to the building. An advantageous orientation for most plant materials is an eastern or southeastern facing site. Planting on the southeastern side of the building provides morning sun, shelter from harsh northwest winds, and protection from the hot drying western sun. Most plants, whether sun loving or shade tolerant, will adapt to this location. An east-southeast facing entrance is an ideal orientation for plantings, and it is also ideal for the activities associated with arrival at the school. The

building is bathed in sunlight rather than hidden in shadow; the morning sun means that rain, ice or snow will begin to dry or melt faster. This is also the best orientation for a children's garden. The least desirable location for gardens and ornamental landscape plantings is the northwest side of the building. These areas are in the shade much of the year and subject to drying winds and hot late afternoon summer sun. Avoid placing major entrances to and exits from the building in these locations, particularly if doors remain open for extended periods as children move to and from outdoor play areas. Plantings at northern and northwestern sides of the building should be carefully selected for tolerance to climate conditions.

<u>Water</u> - Provide hose bibs as a source of water for planting areas. The area around the building will generally be hot due to radiant heat from the storage of the sun's energy in masonry walls, therefore evaporation of water from plants around the building is likely. If water is handy, it is much more likely that watering will occur.

Foundation Planting - Pay special attention to plantings immediately adjacent to the building. This is often the least desirable environment for planting. Large buildings do not need conventional "foundation plantings." They do not have foundations to conceal. Concentrate plantings in groups rather than in long lines all along a face of the building. In areas where there is no planting, consider providing a narrow paved mowing strip to make maintenance easier along the base of the building (See Figure 3 for an example of a mowing strip). Avoid creating narrow planting areas between the building and a pedestrian walkway, as these areas are subject to compaction during construction, dry out quickly, and suffer heat build-ups from the adjacent building.

Planters - Do not design small areas of planting within a large paved area. Plants that are surrounded by paving on multiple sides have a high likelihood of being trampled by students. As with narrow planting strips adjacent to the building foundation, these areas will suffer from the heat and compaction associated with the adjacent paving. Small planting "cutouts" within paved areas often have inadequate drainage and

insufficient root space for good plant growth. Consider raised planters for ornamental plantings near the building entrance or in special pedestrian areas. The potential for trampling small shrubs and flowers will be reduced if plantings are raised above the level of the walkway. Planter heights can range from curb height (6 inches) to seating height (18 inches). The size of the planting area must be sufficient to support the growth habit of the plants within it. Larger is better.

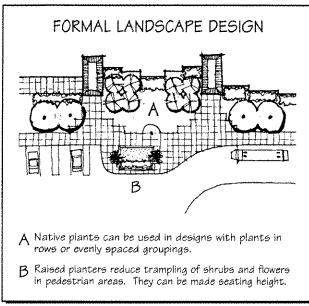


Figure 1

Planters are excellent areas for student planting projects to enhance the appearance of the school. Soil within planters is seldom subject to compaction by machines and it is easier to work the soil in planters than it is to excavate the soil near building or pathways (See Figure 1 for an example of a raised planter at a school entrance).

<u>Circulation</u> - Avoid using plants to control circulation. If a plant is in the way of a pedestrian route, it will not deter a student. The plant will get trampled. Thorny plants such as nonnative pyracantha or barberry are not a solution. They send a message (keep away or be hurt) that is inappropriate for a school environment. To

define a special use area such as a playground or garden plot, and to keep traffic from cutting through, it may be necessary to build a low wall, fence, or berm. Plantings can make these features more attractive, but plants alone will seldom be enough to stop trespassers.

<u>Storage</u> - Provide storage areas for gardening and plant maintenance equipment. The storage should have access from outside of the building.

Landscape Design and Plant Selections

Selecting plants for a school site involves decisions about the visual characteristics of the plants (the artistry of design) and the adaptability of the plants to the site location (plant physiography). Designers seeking the right plant for the right place should make their selection based on the plant's form, color, or texture, and on the plant's place in the local ecosystem. Planting guides and nursery catalogues should be cross-referenced to determine if a plant is native or exotic (a plant from another country or another region of the United States), and to learn the wildlife benefits, ornamental characteristics, and cultural requirements of the plant being specified. As mentioned above, native plants contribute to the unity and harmony of the natural scene within any landscape. But the advantages of using native plants for ornamental landscaping go beyond their regional appropriateness. Native species provide a rich palette of plants with distinctive and desirable sensory characteristics. Prime examples include the multicolored shredded bark of the river birch, the lustrous leaves of the American holly, the delicate white flowers of the shadblow, the fragrance of the spicebush, and the profuse colorful berries of the nannyberry viburnum.

A commitment to using native plants in the landscape does not require that only native plants be specified. There may be cases when nonnative or cultivars of natives are selected for availability, design characteristics, or special site conditions. But a concerted effort should be made to include natives in the school plant palette.

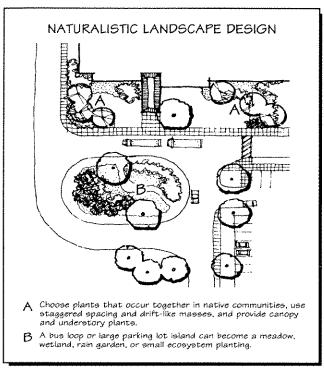


Figure 2

There are two different design approaches to incorporating native materials in a planting design: formal landscape design and naturalistic or ecosystem-based design. Both are valid approaches for the use of native plants on school sites (See Figures 1 and 2).

Native Plants and Formal Landscape Design - The first approach is to substitute native plants for some or all of the plants in a traditional design scheme. Formal rows, even spacing, or ordered groups of plantings may be appropriate to frame an entrance, define circulation through a parking lot or along a path, or create a strong geometry that echoes architectural massing. Native plants can be used effectively in such a design pattern.

Native Plants and Naturalistic Design - The second approach is to use native plants within a design structure that attempts to recreate plant communities or associations found in nature. A naturalistic or ecosystem approach usually employs staggered spacing and mixes species in drift-like plantings. In a plant scheme aimed at mimicking native communities, plants can be spaced closer together than is recommended in many textbooks or landscape

ordinances. This close spacing would reduce the tendency to mow under and between trees and it would allow the plants to close their canopies to make an interconnected mass. A planting plan influenced by native assemblies would use plants in masses, locating them in places that approximate their natural habitat (upland, wetland, streamside, woodland, etc.).

Substitute Natives for Exotics - It is a relatively easy process to substitute native trees for exotic trees in a landscape palette (See Figure 3). There are numerous large shade trees and small ornamental trees suitable for Maryland sites that have ornamental qualities equal to those of nonnative trees. Most have handsome forms and foliage. However, a few native trees may have maintenance concerns that should be addressed. For example, the native sweetgum (Liquidambar styraciflua) with its handsome star-shaped leaf and multicolored fall foliage would be appropriate in a grove, as part of a wetland planting, or in a landscape buffer. However, the native sweetgum often produces a large crop of fruit capsules that could be undesirable on small islands in parking lots, near a storm drain, or along a driveway. A non-fruiting cultivar should be selected for such locations. Ash (Fraxinus) is a native

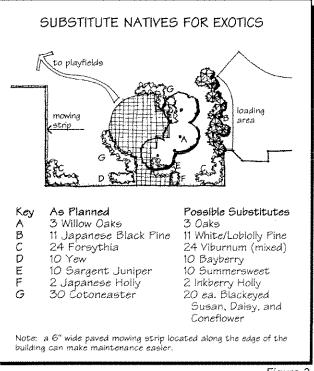


Figure 3

species that tolerates dry or urban conditions. The native varieties produce seeds that have moderate wildlife value. The prolific seeds of this tree can propagate other trees and contribute to future forests. All too often a seedless variety is specified so that natural regeneration of the species cannot occur. Again, the maintenance issue will dictate whether the wild/native or the cultivar will be selected. In a parking lot, the seedless ash or a different native species may be recommended.

Using native shrubs provides a different landscape character than a planting design that features exotic or nonnative plants. Conventional ornamental plantings often rely heavily on exotic broadleaved and needle evergreen shrubs for a year-round green appearance. Certain frequently used exotic plants that are tough and hardy evergreens (junipers, yews, siebold euonymus, cherry laurel) have minimal seasonal Many of these nonnative plants have change. inconspicuous flowers, produce no fruit, and have little wildlife value. By contrast, many of our native shrubs are valued for their showy flowers, profuse fruit, colorful or interesting twigs, attractive fall foliage, and wildlife benefits. Most of the native shrubs suitable for schoolyard planting are deciduous and therefore change their characteristics with the seasons. A few natives are suitable as specimen plants, but most are best used in masses. Because many native deciduous shrubs are coarsely textured when they drop their leaves, a mixture of native and imported plants that includes evergreens or finely textured plants may be desirable for landscaped areas around the entrance to a school building.

Reforestation: The creation of a biological community dominated by trees and other woody plants containing at least 100 trees per acre with at least 50% of those trees having the potential of attaining a two inch or greater diameter within seven years.

Afforestation: Establishment of a tree cover on an area from which it has always or very long been absent.

SITE PERIMETER OR BUFFER PLANTINGS Native plants can be used to screen a road or neighboring property, or to deflect harsh northwest winter winds. A row of native evergreen trees. Pure stands of trees occur in nature. A hegdrow of evergreen and deciduous trees and shrubs. Many native plants provide food and cover for wildlife.

Figure 4

Perimeter or Buffer Plantings - Oftentimes a perimeter buffer is needed to screen the school from a road or from neighboring properties. Dense plantings also may be needed to buffer outdoor use areas from harsh northwest winter winds. The conventional planting solution might be a row of evergreen trees. A monoculture of a native evergreen is an acceptable solution; after all, pure stands do occur in nature. A more interesting approach would be planting a hedgerow. The hedgerow could be a mix of evergreen and deciduous material that emphasizes plants having fruits and nuts for wildlife. Deciduous plants can serve as effective buffers. Deciduous plants and their leaf litter have value for noise reduction and water protection. Planted closely together, hedgerows can provide dense screening in the summertime as many deciduous shrubs grow to a height of 12 feet in a few years. We are used to having more visibility into sites in the winter and accept, even enjoy, a peek into a hidden landscape once the trees have dropped their leaves (See Figure 4).

Native Plant Landscaping and the Forest Conservation Act - Many school construction projects are required to reforest or afforest the school site in compliance with the Maryland Forest Conservation

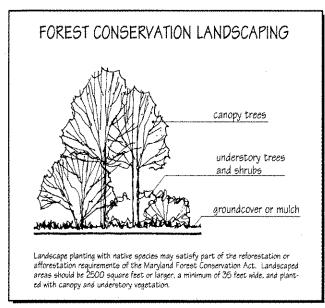


Figure 5

Act. Using naturalistic ecosystem-based landscape design may help satisfy the requirements of the forest conservation act. The forest conservation act allows certain kinds of landscaping to be counted toward the reforestation obligation for a site. Reforestation areas must be at least 2,500 square feet and 35 feet wide, and they need to have canopy, understory, and ground cover layers. In most cases grass is not considered an acceptable ground cover (See Figure 5). Thus, properly designed, a perimeter landscape planting could comply with the requirements of the Maryland Forest Conservation Act.

Site Suitability and Plant Selection

When selecting native trees and shrubs for school site landscaping, one approach is to look at a nearby forest to identify suitable species for planting. If the site conditions after construction of the new school are radically different from those of the adjacent area, this may not be the best approach. Massive grading to create level areas for a large building, playing fields, and extensive paved court areas may have severely disrupted the previous site conditions. Land that may have supported a native forest ecosystem has now been transformed into a very different landscape. The change to the soil is the most important factor affecting plant growth. Prior to development of the school site,

the soil may have had the organic matter, pH, aeration, and moisture holding capacity needed for good forest After construction, most sites are growth. characterized as "urban soils" because the earth has been disturbed, mixed, excavated, or filled over. Urban soils often have a bulk density or compaction that far exceeds that of the site prior to construction. As a result, there is a lack of air in the soil, water will percolate through the soil much more slowly, and roots will have difficulty penetrating the soil. The pH of the soil is also affected by construction. The area around the building is usually the most severely disturbed. Building specifications usually call for a backfill of crushed gravel along the foundation wall. At many sites, construction debris finds its way into the backfill immediately adjacent to the building. These conditions, and leaching of the materials in the foundation slab, can contribute to an alkaline soil Although most specifications call for stripping, stockpiling and re-spreading the existing topsoil of a site, this is seldom accomplished. After construction, most school sites have little, if any, topsoil or organic matter to provide the needed nutrients for plant growth. Thus, the site is no longer innately suited for the growth of many of the plants that previously inhabited the site.

For guidance about planting a site that has been severely disturbed by construction activities, we can look to sites that have undergone natural disturbances for clues to suitable plant use. A school site after development may have much in common with a site denuded by severe weather, pest infestation, or fire. Pioneer plants that invade a site after disturbance, or native plants that grow on dry open landscapes may be more appropriate than the species that made up the forest canopy and understory that once occurred on the site. Consequently, in cases where the site has been severely altered, it may be necessary to choose plants that are suitable to disturbed environments. Selection of plants that adapt to hostile environments should not be a substitute for preparing a site so that it will support healthy plant growth. Plants grown in compacted urban soils, even the most adaptable ones, will not grow as fast nor have as attractive a form as plants grown in a more suitable soil. Preparing the new site so that it will support the forest plants typical of the region is preferable to selecting plants that will have a better chance at surviving in an inhospitable environment.

Finally, plant selection must consider the cold hardiness of the plants. In Maryland, the Coastal Plain is in zone seven, the Piedmont region is in zone six, and the Appalachian Highlands in zone five.

Recommended Plant List

For successful school site planting, the plant palette should consist of species that are available from local suppliers, easy to establish, insect and disease resistant, have a high survival rate, and are tolerant of drought and compaction. The plants selected should have both wildlife and ornamental value. Appendix C is a list of plants that meet most of these criteria. The list is not a comprehensive compilation of native plants nor does it include hard-to-find or hard-to-establish plants. It focuses more on sun tolerant conditions, and therefore, it omits some forest plants that prefer the cool shady locations (hemlock, black gum, beech, hickories, azaleas, rhododendrons, mountain laurel). The strategy for schoolyard planting is very different from that for home landscaping. The flowering dogwood may be the most ornamental of our native understory trees, but it seldom survives or grows well at a school site unless it has good growing conditions (rich, well-drained soil) and adequate maintenance (watering, treatment for anthracnose). The list also avoids plants that may have high wildlife value but that may be messy, short lived, disease prone, or that may have poor form (black cherry, box elder). Many trees suitable for a reforestation planting will not be found on the list as it focuses on native plants for ornamental landscaping. The list does include trees and shrubs that are tolerant of wet soil or inundation, but it does not provide a comprehensive list of plants suitable for creating wetland, pond, or stream habitat areas. Plants are listed by moisture zones in the Wetland Section on page 46. Native perennial flowers and grasses should be considered an integral part of a school landscape planting scheme. The list only includes woody plant species, therefore other publications should be sought for recommendation of native perennial flowers and grasses. Perennials may be specified for new construction, but often they are planted as a part of schoolyard enhancement projects undertaken by parents or teachers who are committed to maintaining these plantings. Black-eyed Susan (the state flower), purple coneflower, and asters are a few

reliable native perennials that do well for mass plantings in high visibility areas. All are suitable choices for planting during new construction.

Plants to Avoid

Invasive exotic materials are non-native plants that pose a threat to native plant communities because of their vigorous growth habit, prolific fruit, or because they may provide such dense shade that they prevent desirable native plants from germinating. Some of these undesirable plants appear on published lists of ornamental plants for landscaping. A list of exotic invasive species appears in the 1991, 1995, and 1998 editions of the Maryland Forest Conservation Manual. The list includes Norway maple, multiflora rose, honeysuckle (most species), autumn olive, Russian olive, Chinese privet, winged or burning bush euonymus, some buckthorn species, oriental bittersweet and many others.

Construction and Installation

Appropriate specifications for site preparation and plant installation area are essential to the success of any schoolyard planting. Soil specifications are as important as the selection of suitable plant material. If the soil is not prepared properly to support plant growth, plant survival and long term growth will be jeopardized. Specifications should include a requirement for soil testing. Landscaped areas should be aerated, organic matter should be tilled into the soil and the pH should be adjusted to the appropriate range prior to planting. The Landscape Contractors Association of Maryland, the District of Columbia, and Virginia publishes guidelines for site preparation, plant installation, and maintenance. These guidelines are an excellent model for the development of landscape specifications.

Long Term Maintenance

Native landscape plants, if chosen appropriately should require less maintenance than conventional ornamental landscaping. All plants benefit from watering at the time of installation and immediately thereafter. Large trees may require watering during dry

periods for two years or more. But once established, native plants that are adapted to the regional and site conditions should be able to survive without supplemental watering and fertilizing. Maintenance can be further reduced by using a naturalistic or ecological-based planting scheme, where plants are massed in compatible groupings. Trees planted in groupings with understory plants or mulch beds will reduce the amount of mowing and trimming required. Landscapes of diverse trees and plants will also favor natural enemies to detrimental insects.

Cost

Landscaping with native plants will not be more expensive than landscaping with ornamental or exotic varieties. It is likely to be less expensive, particularly if native shrubs are substituted for exotic ones. Not only are deciduous plants less expensive than most ornamental evergreen shrubs, a deciduous plant is typically larger than a comparably priced evergreen shrub. When the leaves of a deciduous shrub drop in the fall, they add a natural mulch for that plant. Less watering and mulching may be needed. Native trees may be less expensive than named cultivars selected for their ornamental characteristics. conventional plan that calls for trees in grass may be less expensive than an ecosystem planting that calls for a shrub or groundcover understory. However, in the long-run, maintenance costs may be lower for multilayered plantings. In addition, this type of multilayered planting may be developed as part of a forest conservation plan and thus be absorbed into the budget allocated to satisfy requirements of the Forest Conservation Act.

Student Participation

Initial school construction usually includes the design and installation of major tree and shrub masses and some landscape design associated with key site areas such as building entrances. The planning committee for a school construction project (see Chapter 2) will provide input into these landscaping decisions. Typically, however, school administrators, parentteacher associations, community groups, and students continue the interest in planting efforts after the school has been occupied. Once the school becomes their own, students can participate in any phase of native plant landscaping from planning and design to installation and maintenance. The first step in the process might be an inventory of existing plants and plant communities on the site. By conducting a plant inventory, students can learn about plant and wildlife habitats on the school grounds. As a result, school groups may decide to undertake the creation of a meadow, wetland, or other site development option discussed in this manual. Students can develop schoolyard habitat projects, or they can enhance existing plantings by adding native ornamental shrubs and flowers to special schoolyard areas such as entrances, courtyards, or playgrounds. Projects such as adding perennial flower beds may require extra maintenance and should be undertaken only if school administrators and teachers support the effort, and if volunteers are willing to assume some responsibility for care. This care may involve weekly watering of flowers during periods of drought in the summer. By undertaking native plant landscaping projects, students learn about plant science, gain new skills, make their school more attractive, and come to understand how their actions can improve the environment.

RAIN GARDENS



Corkran Middle School Rain Garden Anne Arundel County Public Schools

Case Study: Rain Gardens

More than 300 seventh graders at Corkran Middle School, Anne Arundel County, participated in a Service Learning Project to create the school's "Rain Garden." The project transformed an interior grassed courtyard into a beautifully landscaped stormwater treatment system that slows down, filters, and removes pollutants from runoff before entering the Chesapeake Bay.

The project was funded by a \$1,000 grant from the Chesapeake Bay Trust with each student contributing more than 10 hours on the project. Art students were responsible for the design of the garden, while math students measured and made scale drawings. Language arts classes wrote articles for the school newspaper and social studies classes raised funds to build benches and bird houses. The science students were responsible for the majority of the labor: tilling the

soil, planting the shrubs and wildflowers, spreading mulch, watering, and weeding.

The rain garden retrofit project was a cooperative effort with many participants including the Maryland Department of Natural Resources, Chesapeake Bay Trust, Save Our Streams, Prince George's County Department of Environmental Resources, Connector Corps, students, and faculty.

The project participants were honored and praised by local government and school officials, environmental groups, and environmentalists.

"You have created the first rain garden in Anne Arundel County, putting Corkran Middle School on the cutting edge of Bay restoration technology," said Ron Gardner of the Department of Natural Resources.

"You have contributed to the beautification of your school and the restoration of the Chesapeake Bay. You should be very proud," said Karina Shipps of the Connector Corps for Service Leaning.

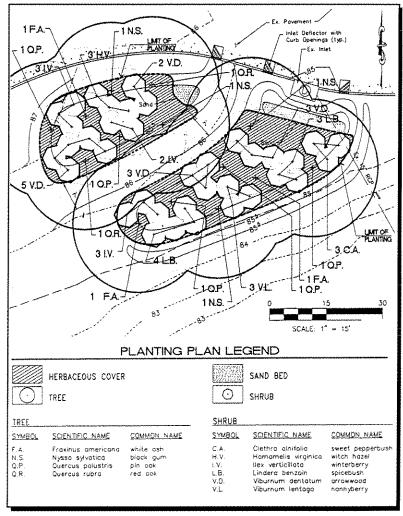
"It has been so encouraging to see the students accomplish this project with such interest and enthusiasm. It is amazing to see how much the students care about and take pride in the rain gardens that they created to protect the environment," said Peggy Sange, Corkran Middle School, Enrichment Teacher and Project Coordinator.

Rain gardens combine hydrologic and environmental benefits with the aesthetic and habitat values of landscaping. Depending on mitigation needs, type of application, plant materials, and site constraints, rain gardens can effectively remove pollutants from runoff, promote ground water recharge, restore watershed hydrology, enhance terrestrial habitat, provide shade to reduce thermal impacts, and improve aesthetics. Monitoring results have shown excellent pollutant removal rates of 60% to 80% for nutrients and 93% to 99% for heavy metals.

Environmental Enhancement

Rain gardens are simply very shallow (2" to 6" deep) landscaped stormwater runoff storage areas. Runoff is captured in these low lying areas to be infiltrated or filtered, allowing the soil and plants to uptake, transform, and remove pollutants. Rain gardens are not wetlands. They are designed to drain quickly allowing the use of typical landscape plants. technique allows landscape and green space to be designed to serve many including functions stormwater management, aesthetics, habitat, and environmental protection. Using the landscape to treat stormwater runoff may reduce the need to use costly conventional stormwater management devices.

Rain gardens are designed using the principles of bioretention, a water quality practice in which plants and soil remove pollutants from stormwater. Bioretention is an alternative cost effective practice that allows the use of landscaped features to achieve runoff controls. Rain gardens are integrated into and uniformly distributed throughout a site's forested areas, green space, drainage swales, streetscapes, median strips, or parking lots. The term rain garden implies the use of bioretention measures in a highly visible area where a more aesthetically pleasing (garden like) design is desirable.



Typical Planting Scheme for a Rain Garden

Figure 6

Rain gardens are modeled after a terrestrial upland soil/forest composed of native upland trees, shrubs, and herbaceous plants. This system is not dependent on a constant source of water thereby reducing the need to destroy additional riparian forest or wetland areas by building conventional stormwater ponds.

Rain gardens maximize the use of physical, chemical, and biological pollutant removal processes to treat runoff. They are small models of natural forest ecological systems that demonstrate how the landscape functions to protect the integrity of a watershed's aquatic and riparian ecosystems. Their designs also demonstrate the interconnections of a wide array of environmental and engineering principles and disciplines including the hydrologic cycle, nutrient cycles, biology, forestry, soil chemistry, ecology, horticulture, and landscape architecture.

Planning, Design, and Construction

Key factors in the design and construction of rain gardens are careful selection of plant materials that can tolerate extreme hydrologic changes, good drainage to prevent creating anaerobic conditions, safe conveyance of overflows, careful use, inspection and control of backfill soils and careful inlet/outlet controls to prevent erosion.

Rain gardens consist of a shallow ponding area (6" deep or less), mulch layer, sandy planting soil, plant materials and, where appropriate, the use of under drains. The design can vary greatly to accommodate site constraints, ground water recharge, soils, habitat/ ecological objectives, watershed hydrology, and aesthetics. The facility must be well drained by infiltration (where soils allow) or by under drains or both. Stored water runoff soaks into the ground over a period of less than a day into the underlying soils or to an under drain which discharges to a swale or pipe.

Specific configurations and locations of the rain gardens are determined after site constraints such as location of utilities, ground water level, steep slopes, underlying soils, existing vegetation, and drainage are considered. Where soil infiltration rates are lower than 1 inch/hour or in order to extend the life of the rain

garden, under drains should be used to ensure good drainage.

The drainage area for one rain garden should generally be between 0.25 and 1 acre. Multiple rain gardens are needed for larger drainage areas. The storage volume of the rain garden will be determined by the desired level of control (e.g., first half inch of runoff) and dewatering capabilities of the design. Rain gardens work best when there are many facilities with small drainage areas. Large facilities with large drainage areas tend to allow soils to remain saturated for longer periods creating poor drainage conditions, stressing the plants, and reducing the pollutant removal effectiveness.

The maximum ponding depth of the bioretention area should be 6 inches. This depth provides for adequate storage and prevents excessive ponding periods. Water ponding for longer than three days restricts the type of plants that can be used and may encourage mosquitoes to breed.

A minimum planting soil depth of 2 feet is recommended. This depth will provide adequate soil for plant root systems and soil reactions to remove pollutants. Planting soil should be lightly compacted until the desired depth is reached.

Planting soil should be sandy loam, loamy sand, or loam texture and have clay content of 10 percent or less. The pH of the soil should be between 5.5 and 6.5. Pollutants (e.g., organic nitrogen and phosphorous) can be absorbed by the soil and microbial plant activity can flourish within this pH range. The planting soil should contain 3 to 5 percent organic content.

Native species of plants are recommended because they are tolerant to the regional climatic, soils and hydrology. The designer should assess aesthetics, site layout, habitat objectives, and maintenance requirements when selecting plant species.

After placing the trees and shrubs, the ground cover and/or mulch should be established. Ground cover such as grasses, legumes, or flowers can be used. Two or three inches of commercially available fine shredded hardwood mulch or shredded hardwood chips should be applied to provide erosion protection.

Specific Design Applications and Modifications

Rain gardens have a wide variety of applications. However, the designer must carefully consider the unique problems presented by each application.

Parking Lot Islands, Median Strips, and Formal Landscape Islands Around Buildings - Care must be taken to ensure that infiltration and ground water seepage will not adversely affect the structural integrity of roadways or buildings. The careful attention to

grading, location, and use of under drains can minimize these problems. It is important to divert rain garden overflows to inlets or grass areas in order to prevent deposits of sediment and debris onto parking surfaces.

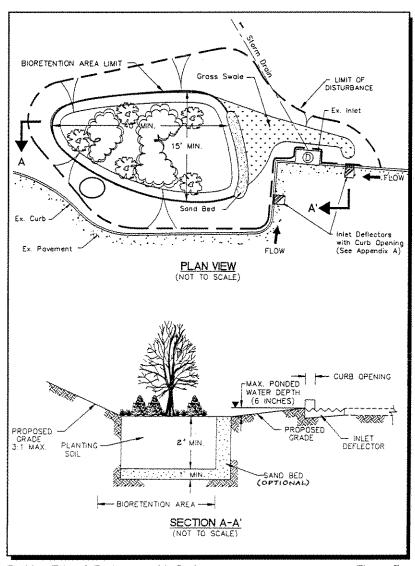
Forested Areas - In some cases, existing forested areas can be converted to rain gardens by constructing small berms to allow no more than 2 to 4 inches of ponding water. Care must be taken to ensure the existing soils have high infiltration rates (1 inch/hr or higher) and can infiltrate the ponded water in less Excessive ponding than 12 hours. (greater than 24 hours) will adversely affect mature trees which are not tolerant of extreme changes in hydrology. Also, adequate measures must be taken to reduce the erosion potential of directing increased volumes and concentrated flows into existing forested areas.

Fringe Forest Areas - The rain garden can be used for re-vegetation of forest fringe areas to create a forest community and fringe habitat ecosystem. These areas would consist of trees, a subcanopy of understory trees, a shrub layer, and ground covers. Plants can be selected for their habitat value (food, shelter, and nesting materials).

Open Space Meadows - Areas which are not used for recreation or other

purposes can be designed as rain gardens. Where soils and topography allow, wild flower meadow basins can be constructed. Care must be taken to prevent erosion and to disperse flows throughout the bottom of the rain garden basin.

<u>Open Swales</u> - Rain gardens should not be used in the direct flow of an open swale. Since erosion may occur due to high velocities and concentrated flows, rain gardens can be used adjacent to a swale in an off line configuration.



Parking Edge & Perimeter with Curb

Figure 7

Landscape Trees - A simple application of a rain garden is to grade shallow depression storage areas around each individual tree. Careful selection of water tolerant trees can allow ponding depths of 2 to 3 inches extending in an 8 to 10 foot diameter around each tree.

Retrofit Existing Areas - Green space and landscaped areas can sometimes be converted to rain gardens. The most convenient areas to retrofit are near existing storm drain inlets. The area adjacent to an inlet can be regraded and landscaped to capture and treat runoff. A good example is the Corkran Middle School case study (page 22) where the courtyard drain was raised about 4 inches to create a shallow storage area around the inlet.

Limitations

Rain gardens relying on infiltration alone for dewatering should not be considered where the water table is within 4 feet of the ground surface and when the surrounding soils are unstable. The practice is also not recommended for areas with steep slopes greater than 25 percent or where mature tree removal will be required.

Long Term Maintenance

Rain gardens require routine periodic maintenance (e.g., mulching, plant replacement, pruning, and weeding) typical of any landscaped area. No special maintenance equipment is needed. Routine maintenance costs will increase proportionally to the number of plants used and area planted. The use of shallow depth under drains will reduce the chance of poor drainage due to clogging and the cost to excavate and replace soils and plant materials.

Cost

Rain garden costs are most attractive when compared to structural practices such as ponds. Cost savings over conventional stormwater practices can vary widely depending on unique site conditions. Savings of 10% to 25% over conventional practices have been achieved in the application of rain gardens to residential, commercial, and industrial sites. They do not require additional space as they are integrated into the existing landscape features. They require some additional costs related to the increased number of plantings, additional soil investigations and under drain systems. The use of meadow rain gardens to replace open space turf will have higher site preparation and plant materials costs but less long term maintenance costs than turf.

Student Participation

Rain gardens are easy to plan, design, and care for. Any of these aspects can be used to develop hands-on participation projects by students and school staff to retrofit schools grounds or to modify or care for existing rain gardens. Since they demonstrate a number of environmental principles, rain gardens are ideal for science studies and projects that demonstrate the hydrologic cycle, impacts of land use on the environment, and the creation of plant and wildlife habitat.

Regulatory Requirements

Regional landscaping and stormwater manuals should be consulted to ensure that the rain garden areas meet the landscaping and stormwater requirements established by the local authorities.

FORESTS



Choosing Plants Sussex Elementary School Baltimore County Public Schools

Case Study: Forests

Sussex Elementary School is located adjacent to Duck Creek in the Essex area of Baltimore County. Since 1990, teachers have been developing and implementing an environmental education program which has been successfully integrated into all areas of the curriculum. The project coordinator, Kathy Olver Brauer, says that the school staff has attempted to infuse environmental education into every facet of the students' school experience. Teachers have been provided with extensive staff development. The program emphasizes a hands-on approach, giving students not only information but also many opportunities for real world experiences.

An integral part of the program is the school's partnership with the Baltimore County Forestry Board. The board has assisted at nearly every step of the program by providing guidance, resources, and funding.

The project began in the Spring of 1990 with a Baltimore County Board of Education staff development grant of \$500 to provide training on wetlands. In the summer of 1990, the Board of Education awarded the school with a teacher incentive grant of \$12,000, for

the Duck Creek Project. These funds provided staff development and materials related to wetlands and environmental education. In the spring of 1991, the Baltimore County Forestry Board made training available and provided trees and shrubs to plant along Duck Creek as a buffer zone.

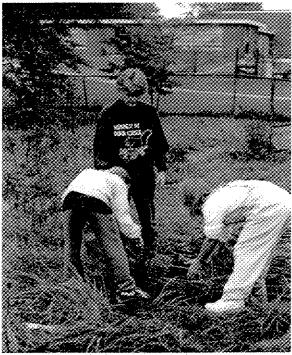
Since 1991, teachers have developed and implemented a summer environmental education camp for elementary students. After-school programs have included environmental science, water monitoring, and schoolyard reforestation. Middle and high school students participate in these programs to earn service learning credits.

In 1991, the Chesapeake Bay Trust provided funding to produce a newsletter, *Duck Creek Quarterly*, on environmental education for teachers in Baltimore County. In 1994, the Trust provided funding for additional plantings in the buffer zone. Also, in 1994, the Chesapeake Bay Trust and the U.S. EPA provided funding to create an environmental telecommunication network for elementary schools. Training included: Save Our Streams, telecommunications, and the Baltimore County Forestry Board Schoolyard Reforestation Program. Participating schools were provided with telecommunication equipment, guides, and water quality testing materials. This aspect of the project was presented at a Maryland Association of Science Teachers annual meeting.



Planting along Duck Creek Sussex Elementary School Baltimore County Public Schools

In 1994, the Baltimore County Forestry Board and the National Tree Trust provided seedlings, potting soil, and pots to establish a schoolyard nursery. Students pot seedlings and allow them to grow for one year at which point they are planted in the creek buffer zone. In 1998, the Baltimore County Forestry Board provided trees and shrubs to expand the buffer zone along the creek. Planting involved students, teachers, and parents.



Planting along Duck Creek Sussex Elementary School Baltimore County Public Schools

Environmental education is an ongoing part of the curriculum at Sussex Elementary School. Additional activities have included garden projects, specialized staff development, development of a nature trail, water safety, hatching and releasing yellow perch, and water quality monitoring.

Environmental Enhancement

From the mountains to the Chesapeake Bay and the shores of the Atlantic Ocean, forests contribute greatly to the quality of life. Air quality is enhanced by forests which reduce atmospheric carbon dioxide through photosynthesis, filter particles, and absorb nitrates. Streams and associated aquatic life benefit from having forests anywhere in their watershed. Forests promote groundwater recharge as rain trickles through leaf litter into the ground. Clean, local groundwater is critical in maintaining stream water quality and a healthy balance of aquatic life. Forests moderate water temperature through shading and reduce the amount of sediment and other pollutants entering streams. Forests provide habitat for numerous plants and animals, and also provide recreational opportunities for people.

Regulations

Early in the 19th century, much of Maryland's forest cover had been cleared for agriculture or cut for fuel, timber, or charcoal. Currently, the loss of forest cover occurs primarily as a result of increased urban development. Unlike forest clearing for agriculture, clearing for development typically eliminates the regeneration potential of forests.

In 1990, the Governor's Task Force on Trees and Forests was created to assess the problems facing Maryland's trees and forests, identify solutions to these problems, and promote good land stewardship and protection. One recommendation was the creation of a forest conservation, protection, and reforestation law. The Maryland Forest Conservation Act subsequently was passed by the General Assembly in 1991 and most recently amended in 1997 and 1998 to conserve the State's forest resources during land development.

For all major school construction projects both new and renovations/additions, the requirements of the Maryland Forest Conservation Act and Regulations must be addressed. The Forest Conservation Act and Regulations (NRA Title 5 Subtitle 16 and COMAR Title 8 Subtitle 19) apply to any activity that requires an application for subdivision, grading, or sediment control permit on areas greater than 40,000 square feet. A forest stand delineation report and a forest conservation plan for the site must be submitted for approval to the Maryland Department of Natural Resources (MD DNR) Forest Conservation Program prior to permit approval. These plans are prepared by

a Maryland licensed forester, Maryland licensed landscape architect, or other qualified professional. The forest stand delineation report includes an environmental features map as well as specific information on the existing forest and other natural features on the site. The forest conservation plan indicates the amount of forest disturbance, the methods to be used to protect the remaining forest, and the reforestation or afforestation required for the project. Planting must meet the stocking and survival requirements as stated in the regulations and must also have a two-year maintenance agreement that requires a percentage of the stock to survive for two years. Any planted or retained forest must have a longterm protective agreement that provides for the protection of the afforestation and reforestation areas. This protection allows for uses that are consistent with forest conservation, including recreation.

Planning, Design, and Construction

Conserving as much forest as possible on a construction site is an economical and environmentally sound practice. Temporary stormwater management during construction is lessened and permanent stormwater management requirements are reduced. Another benefit is that the more forest that is retained, the lower the forest mitigation requirement. For the forest remaining on a site, a forest stewardship plan can be developed by the county forester to meet the objectives for the forest. These objectives can include educational opportunities, wildlife habitat, safety, and income.

Some consider grass a less expensive alternative to planting trees. Grass costs less to plant than trees and may require less site preparation. However, grass will represent significantly greater long-term maintenance costs.

Compliance with the State Forest Conservation Program will require field work (a forest stand delineation report) and the preparation of an additional construction plan (a forest conservation plan). The forest stand delineation identifies the existing forest cover and environmental features on the proposed development site. The forest stand delineation plan should be completed prior to proceeding with the schematic design phase of a project. The forest

conservation plan indicates the limits of disturbance for the proposed project, the mitigation planting plan, and how existing forested and sensitive areas will be protected during and after development. This plan is part of the site plan and construction bid package. It is submitted to the State Forest Conservation Program for review at the same time as the application for grading or sediment control permit is submitted for review to the appropriate agencies.

The planting of trees involves the purchase of planting material, some site preparation, and maintenance to ensure survivability. This work is usually part of the landscape/planting contract. A warranty is typically part of the contract and this covers the plants survivability for the first two years.

There are three types of planting stock readily available for school sites: seedlings, containerized, and ball and burlap. Seedlings are an average of 12 to 15 inches in height. Containerized plants are sold in pots. Ball and burlap are larger. It is recommended that the future use of the site be taken into account when determining the planting material. A mix of planting material is also recommended. Larger planting stock, ball and burlap, and containerized stock, can be located closer to high use areas while smaller material (seedlings) should be planted in the low use areas or behind the larger stock.

Site preparation and maintenance may be required, depending on the site. Site preparation may include, for example, disking and fertilizing the ground. Maintenance can include watering, pruning, and insect and disease control.

School Projects for Trees and Forests

Often schools are built on old farmland or a forest area that is cleared. Typically individual, widely spaced trees are then planted, which, although valuable, do not make the land considered forested. Forests are valuable because they not only provide food, shelter, and cover for many animals, but they reduce runoff by soaking up water and filtering out impurities, cool the air and recycle carbon dioxide back into oxygen. The forest floor, with its bed of leaves and plants, acts as a sponge to soak up rain. It also provides additional habitats because of the decay that is occurring there.

A variety of trees is important to an area because they provide for the different needs of the many animals that use them. Some trees produce seeds or nuts that are food for birds and squirrels. A large oak tree can provide enough acorns to feed many animals. Other trees produce a fleshy fruit used by birds and insects.

Trees of different sizes are necessary to create an overstory and understory in the planted forest. Some birds nest low to the ground while others will only nest high in the canopy. Birds of prey need tall trees for perching while other birds use the branches of smaller trees to hide.

There are many tree planting projects that may be helpful to conserve or enhance the natural environment of the school site. Among the projects that can be accomplished are:

Riparian Forest Buffer - Trees planted along streams are recognized as effective in protecting water quality. Forests filter sediment and control runoff. A stream buffer should extend a minimum of 25' plus four additional feet for each one percent of slope on either side of the stream.

Slope Plantings - Tree and shrub planting on slopes can be an effective means of reducing mowing and the potential for erosion.

<u>School Forests</u> - A selected area can be planted in seedlings or saplings. Subsequent outdoor activities may include the study of how trees grow and how factors such as insects, disease, and nutrient uptake influence tree survival and growth.

Forest Nursery - Seedlings are potted, grown, and cared for by students and staff until they are large enough to be transplanted. Contact Forestry Board or TREE-MENDOUS Maryland for information about seedlings, pots, and soils.

<u>Screening/Shading</u> - Trees can be planted to serve as a screen, suppress winds, add aesthetic value, or provide shade to a play area, building, or parking lot.

Chesapeake Bay School Reforestation Project

This program is designed to promote environmental protection and education through planting trees on school grounds. The goal of the project is for students and the school community to organize and implement the planting of a native forest to demonstrate its potential for improving the quality of the Chesapeake Bay, local streams and waterways, and wildlife habitat.

The project involves a broad spectrum of citizens through a cooperative effort of public school systems, County Forest Conservancy District Boards, the MD DNR Forest Service, local governments, and the private sector.

With direct student involvement, the school staff develops activities that integrate with school curriculum. Projects include an evaluation process and follow-up care and maintenance program demonstrating ownership and commitment to the planting site. The forester checks the sites periodically to provide advice on maintenance and management.

Local Forestry Boards select the projects to be considered for funding, then submit the project plans to the Executive Committee of the Maryland Association of Forest Conservancy District Boards. Grants are awarded to provide planting stock and materials which are ordered from local private nurseries or state nurseries.

Technical assistance is available from the MD DNR Forest Service. Foresters will assist in writing grant proposals and planting plans, and ordering planting stock and materials.

Forestry Boards have established more than 200 school forests under this project with sites in every Maryland county and Baltimore City.

Long Term Maintenance

Normally there is a one or two year plant survival warranty that is part of the planting contract. The State Forest Conservation Program requires a two-year maintenance agreement on the reforestation or afforestation planting plan as part of the forest conservation plan. If a planting contract includes a one year plant survival warranty, the school system is responsible for the second year of this requirement. For this reason, school systems should require a twoyear plant survival warranty in the construction documents of a project. After this time period, the maintenance can be done by maintenance staff or students. Maintenance may include removal of the planting stakes and guy wires, yearly mulching, watering, pruning of dead limbs and branches, and insect and disease prevention.

Long term maintenance of planting areas or existing forested areas may be necessary to keep the forest healthy. A forest stewardship plan can be written that describes the necessary work and provides a timetable. The work may be done by students or professionals depending on the skill levels required.

Cost

Construction costs are dependent on the size of the site, the amount of forest disturbance, and the size of the reforestation or afforestation mitigation planting. The Forest Conservation Act allows for the removal of forests for development to a certain point before requiring reforestation to occur and requires afforestation if development occurs on a site without forests.

The costs involved in planting a school forest are dependent on plant material (size of material and species selected) and site preparation needed prior to planting. These costs will fluctuate based on the area of the state in which the planting site is located. The MD DNR Forest Service county forester will be able to assist with determining the planting material and site preparation needed prior to planting.

Seedlings can be purchased from the John S. Ayton State Forest Tree Nursery (1-800-TREESMD). Ordering must be done in late fall and the seedlings will be delivered in early spring. Seedlings are very reasonably priced and catalogs are available from the nursery.

Containerized plants can be purchased at most nurseries. Prices vary depending on container size, the nursery, and your location in the state. TREE-MENDOUS MD, a MD DNR Forest Service program, sells containerized trees and shrubs.

Ball and burlap plants can, like containerized plants, be purchased at any nursery. Prices vary depending on size, the nursery, and your location in the state. Generally ball and burlap plants cost more than containerized plants.

Preparation may be required for your planting site. This may include sod removal, tilling of the soil, and predigging holes for larger planting material. After the planting, post-planting site work will need to be done. This includes mulch and stakes. The costs for these items are variable and site dependent.

Student Participation

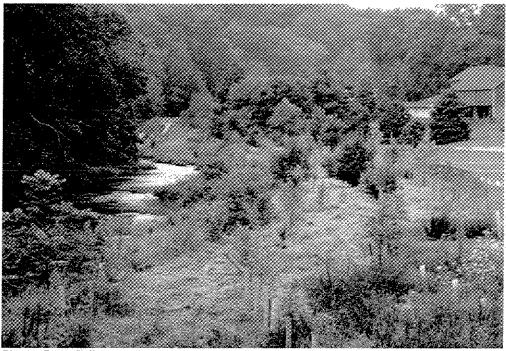
Students can, under the guidance of school staff, conduct site surveys and wildlife habitat assessments, write grants, develop schoolyard planting plans, and install and maintain the plants.

Site surveys require the students to inventory the existing site conditions and develop a map that reflects the information. This information is used to develop a school forest plan. With this information, a forest stewardship plan can be developed which guides the management of the forest to meet the objectives of the school. Objectives can range from wildlife habitat to creating access to study areas. The students can develop planting plans and plant material lists, and install and maintain plant material. Maintenance can include watering, nesting box care, pruning, filling bird feeders, and conducting structural repairs. In order to pay for the planting material, the students can apply for grants. Students can also write news releases about their projects.

Safety

As part of the forest stand delineation report, existing forest is evaluated to determine its ability to withstand and survive the proposed construction activity and future use of the property. Individual trees are also evaluated to determine if they pose a risk to construction workers or subsequent property users. Those areas considered at risk or that pose a risk to people may be targeted, when practical, as the area to be developed or for selected tree removal.

If there is a question about the safety associated with one or more trees on a school site, the regional forester should be contacted for an evaluation of the problem. The Forest Service will evaluate the situation and give recommendations on the proper action. Planted areas, if designed and planted without safety in mind, can become a security issue. In areas where visibility is a priority, certain trees such as rows of conifers should not be planted. Deciduous trees and shrubs should be planted instead. Plant material can also be pruned to allow easier visibility. The MD DNR Forest Service can give recommendations on tree species and correct pruning techniques.



Riparian Forest Buffer Eden Mill Nature Center